# Where do they all come from? Animal movement immediately following a hummock grassland fire.

**Gerry Swan[1] & Steve Wilson[2]**

[1] 2 Acron Road, St Ives NSW 2075. gerryswan@axtsystems.com

[2] 1042 Dayboro Road, Kurwongbah Qld 4503

## ABSTRACT

A fire through hummock grassland in Western Queensland adjacent to a gas pipeline trench resulted in a 650% increase in the number of animals that were recovered from the trench in the seven days following the fire compared to the seven days prior. Those lizard species that shelter within spinifex or grass clumps, such as *Tiliqua multifasciata*, *Ctenotus leonhardii, C. pantherinus, Lialis burtonis* and *Strophurus elderi* had the largest increases, and the mammals *Pseudomys desertor* and *Planigale tenuirostris* showed similar increases. Species that typically shelter in burrows or ground cracks showed a decline in numbers recorded following the fire. Seven days after the fire event 91 animals were removed from the last 3km of open trench. However, no animals were ever observed moving across the burnt areas during the day. So where they came from and when they travelled remains unanswered.

**Key words:** fire, lizards, snakes, rodents, marsupials, small mammals, arid, pipeline trench, hummock grassland.

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## Introduction

During the construction of a gas pipeline between Wallumbilla in Queensland and Moomba in South Australia (SA) during 2010-2011 we had the unique opportunity of seeing the impact of a fire on fauna in hummock grassland in western Queensland between Ballera and the SA border.

Checking the open trench immediately following the fire we removed 170 animals from a 1km section of trench compared with 2 animals in the same kilometre one day prior to the fire. There was an increase of more than 800% in the total number of animals in 25 km of open trench the day after the fire compared to the number removed the day before, and this continued unabated until the trench was filled in.

We were employed as the fauna handlers to remove and release fauna that fell into the trench constructed to bury the pipe. In effect the trench acted as a giant pitfall sometimes more than 40 km long. During the course of this project we removed 15,010 animals from the 943 km trench.

In November 2011, on Nappa Merrie Station approximately 30 km west of Ballera, a lightning strike caused an extensive fire in the spinifex grassland which burned for several days. A light changeable wind caused flare-ups but rain finally extinguished it altogether. At the time of the fire there was 31km of open trench leading into Ballera. Habitat was burnt along either one or both sides of a 25 km length of the trench. Nearly everything was burnt (Figures 1 and 2) although there were isolated small unburnt areas ranging from 20-50 m$^2$ in size, and some unburnt drainage lines 8-10 m wide.

The day following the fire we were able to check the open trench immediately adjacent to where the fire had burnt.

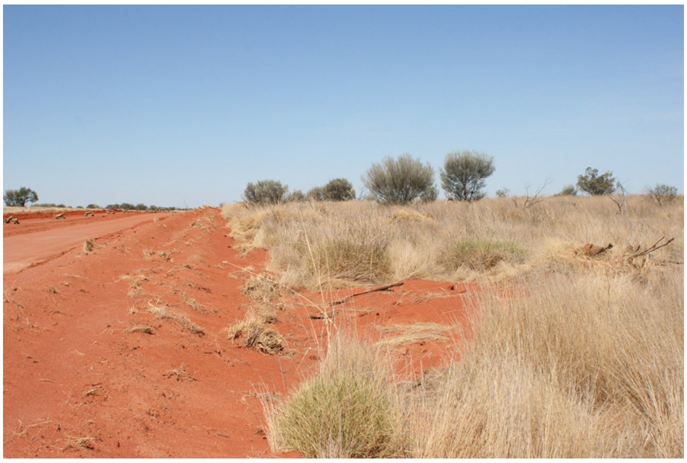

**Figure 1.** Habitat adjacent to the ROW before the fire.

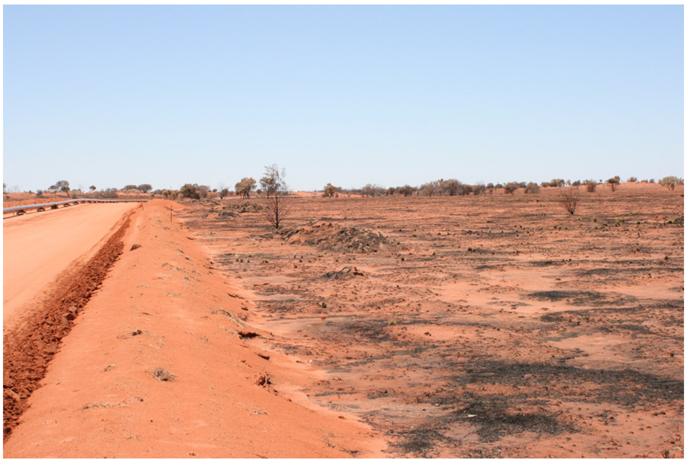

**Figure 2.** Habitat adjacent to the ROW after the fire.

While we anticipated that there might be an increase in the number of animals in the trench the surprise was the sheer volume. Most of the species found after the fire had been recorded previously but only in low numbers. Clusters of Centralian Blue-tongues *Tiliqua multifasciata* were huddled together under the sawdust bags, intermingled with Spinifex Delmas *Delma butleri* and Burton's Snake-lizards *Lialis burtonis*, plus numerous Leopard Ctenotus *Ctenotus pantherinus* and Common Desert Ctenotus *C. leonhardii*. Not only lizards but small native mammals and rodents were present in large numbers, in particular the Desert mouse *Pseudomys desertor* and Narrow-nosed Planigale *Planigale tenuirostris*. Sometimes there were more than 20 animals under one shelter.

## Methods

The trench was dug on one side of a 30m wide cleared Right of Way (ROW) and was usually 1.5 m deep and about 70 cm wide with escape ramps every 500 m. The spoil from the trench (ca 1.5-2 m high) was next to the trench at the edge of the ROW. A refuge-based system was used, placing moistened, sawdust filled hessian sacks in the bottom of the trench at approximately 250 m intervals. These offered stable, humid shelter sites and proved an effective way of daily monitoring the open trench.

The fire burned along both sides of a 25 km length of the ROW. Safety requirements necessitated the removal of all crews from the fire zone while it was burning, preventing us from actually observing any animal activity at the fire front. The pre and post-fire capture results, each covering 7 days, are for this 25km length of open trench in the area burnt. However, post-fire the length of open trench decreased progressively each day as pipe was lowered in and the trench backfilled.

The post-fire relocation was a problem. Our normal protocol was to relocate animals adjacent to where they were removed from the trench, at an appropriate distance and in suitable shelter sites. However the fire left only open ground and ash so the animals had to be relocated several kilometres away in unburnt habitat. Because we were in a remote location with no means of obtaining containers needed to hold animals separately, we had to improvise. Figure 3 shows one of the large tubs we used to hold and move the animals. Several sacks were placed in the tubs to provide some shelter for smaller animals.

Our priority on site was the capture of animals that had fallen into the trench and their relocation to an area where they could be released. Only animals caught were recorded, those that evaded capture did not get entered into the database. Because we were not allowed into the trench, animals could only be caught from the top using hooks and hoop bags on long poles. In some instances animals evaded capture and moved back along the trench. We did not have the time to devote lengthy periods pursuing elusive animals, so these were left to catch the next day. As such, the recording of capture rates in the trench is intended to simply provide information of the number of individuals of each species that were removed from the trench while the pipeline was under construction – the data gathered was never intended for complex analyses.

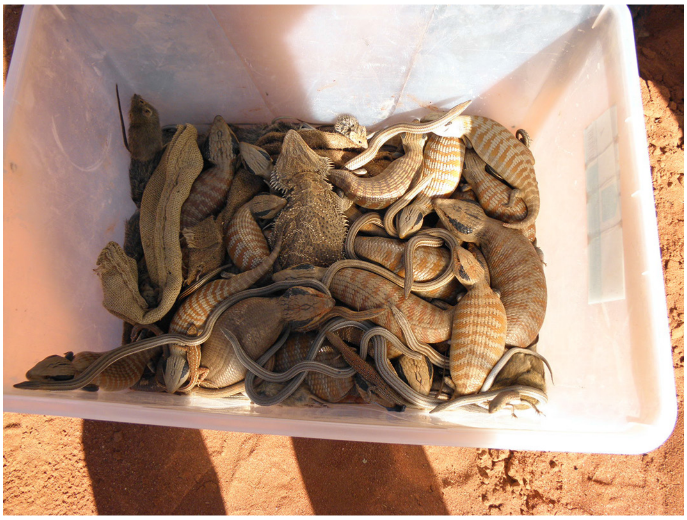

**Figure 3.** A few animals being held pending relocation.

All animals removed from the trench during the course of the pipeline construction were identified to species level, released adjacent to the ROW and co-ordinates taken. These data were provided to the Queensland wildlife database. Taxonomic nomenclature in this paper follows Wilson and Swan 2014 and Mecke *et al* 2013 for reptiles, and Menkhorst and Knight 2011 for mammals.

## Results

Table 1 sets out the species and numbers recorded along the 25km of burnt out area in the 7 days prior to the fire and the species and numbers recorded in the same area in the 7 days after the fire. In total 45 species of vertebrate were removed from the trench, comprising 5 species of mammals, 37 species of reptiles, and 3 amphibians.

For the 7 day period prior to the fire the overall number of mammals, reptiles and amphibians combined was 227. By contrast the number recorded for these groups combined post-fire was 1493. Further, the trench length post-fire became progressively shorter as pipe was lowered in and the trench backfilled. The average encounter rate per day per km pre-fire compared to post-fire and adjusted for trench length is set out in Table 2.

For mammals, three species were recorded from the 25km of open trench during the 7 days prior to the fire, and none of these were encountered in large numbers. Post-fire one of these species was encountered in moderately high numbers (*Rattus villosissimus* from 13 to 38 individuals), two species (*Notomys alexis* and *Sminthopsis macroura*) declined in the number encountered, and two species not recorded along this 25km of trench before the fire (*Planigale tenuirostris* and *Pseudomys desertor*) were encountered, one (*Pseudomys desertor*) in very high numbers.

For reptiles the encounter rates post-fire compared to pre-fire were complex. 33 species were recorded in the 7 days pre-fire but only two of these were from more than 20 individuals.

A drop in post-fire encounter rate was recorded for 19 species of reptiles. Little can be drawn from a comparison of the encounter rates for 14 of these species given the low numbers (6 or less) recorded both pre and post-fire.

**Table 1.** Species removed from the same 25km of trench in the 7 days before & 7 days after the fire.

| Species | Common name | Pre-fire | Post-fire |
|---|---|---|---|
| *Planigale tenuirostris* | Narrow-nosed Planigale | 0 | 41 |
| *Sminthopsis macroura* | Stripe-faced Dunnart | 7 | 4 |
| *Notomys alexis* | Spinifex Hopping Mouse | 2 | 0 |
| *Pseudomys desertor* | Desert Mouse | 0 | 356 |
| *Rattus villosissimus* | Long-haired Rat | 13 | 38 |
| *Ctenophorus isolepis* | Central Military Dragon | 0 | 10 |
| *C. nuchalis* | Central Netted Dragon | 9 | 18 |
| *C. pictus* | Painted Dragon | 3 | 8 |
| *Diporiphora winneckei* | Canegrass Dragon | 1 | 0 |
| *Pogona vitticeps* | Central Bearded Dragon | 15 | 45 |
| *Tympanocryptis tetraporophora* | Eyrean Earless Dragon | 0 | 1 |
| *Varanus gouldii* | Sand Goanna | 21 | 6 |
| *Diplodactylus conspicillatus* Complex | Burrow-plug Gecko | 3 | 0 |
| *D. tessellatus* | Tessellated Gecko | 4 | 19 |
| *Gehyra versicolor* | Eastern Tree Dtella | 6 | 10 |
| *Heteronotia binoei* | Bynoe's Gecko | 6 | 2 |
| *Lucasium damaeum* | Beaded Gecko | 1 | 0 |
| *Nephrurus levis* | Smooth Knob-tailed Gecko | 7 | 1 |
| *Strophurus ciliaris* | Northern Spiny-tailed Gecko | 4 | 1 |
| *S. elderi* | Jewelled Gecko | 2 | 64 |
| *Delma butleri* | Spinifex Delma | 3 | 86 |
| *Lialis burtonis* | Burton's Snake-lizard | 9 | 142 |
| *Pygopus nigriceps* | Western Hooded Scaly-foot | 3 | 4 |
| *Ctenotus leonhardii* | Common Desert Ctenotus | 6 | 203 |
| *C. pantherinus* | Leopard Ctenotus | 11 | 179 |
| *C. regius* | Royal Ctenotus | 12 | 4 |
| *C. helenae/saxatilis complex* |  | 2 | 1 |
| *C. schomburgkii* | Barred Wedge-snouted Ctenotus | 1 | 0 |
| *Eremiascincus phantasmus* | Ghost Skink | 14 | 1 |
| *E. richardsonii* | Broad-banded Sand-swimmer | 2 | 1 |
| *Lerista labialis* | Eastern Two-toed Slider | 1 | 0 |
| *Tiliqua multifasciata* | Centralian Blue-tongue | 6 | 200 |
| *Aspidites ramsayi* | Woma | 1 | 0 |
| *Ramphotyphlops endoterus* | Desert Blind Snake | 4 | 1 |
| *Brachyurophis fasciolatus* | Narrow-banded Shovel-nosed Snake | 0 | 1 |
| *Demansia psammophis cupriceps* | Yellow-faced Whipsnake | 0 | 5 |
| *Pseudechis australis* | Mulga Snake | 20 | 10 |
| *Pseudonaja aspidorhyncha* | Strap-snouted Brown Snake | 1 | 0 |
| *P. mengdeni* | Western Brown Snake | 6 | 11 |
| *P. modesta* | Ringed Brown Snake | 2 | 1 |
| *P. textilis* | Eastern Brown Snake | 3 | 0 |
| *Suta suta* | Curl Snake | 12 | 1 |
| *Litoria caerulea* | Green Tree Frog | 3 | 6 |
| *L. rubella* | Desert Tree Frog | 1 | 10 |
| *Limnodynastes tasmaniensis* | Spotted Marsh Frog | 0 | 2 |
| TOTALS |  | **227** | **1493** |

**Table 2.** Number of animals taken from the same 25 km of trench each day pre-fire and each day post-fire

| Days pre-fire | No. animals | Km of open trench pre-fire | Average No. of animals per km pre-fire | Days post-fire | No. animals | Km of open trench post-fire | Average No. of animals per km post-fire |
|---|---|---|---|---|---|---|---|
| 1 | 42 | 25 | 1.7 | 1 | 252 | 25 | 10.1 |
| 2 | 32 | 25 | 1.3 | 2 | 300 | 22 | 13.6 |
| 3 | 37 | 25 | 1.5 | 3 | 237 | 19 | 12.5 |
| 4 | 26 | 25 | 1.0 | 4 | 192 | 15 | 12.8 |
| 5 | 24 | 25 | 1.0 | 5 | 191 | 13 | 14.7 |
| 6 | 35 | 25 | 1.4 | 6 | 230 | 8 | 28.8 |
| 7 | 31 | 25 | 1.2 | 7 | 91 | 3 | 30.3 |

However five species (the skinks *Ctenotus regius* and *Eremiascincus phantasmus*; the varanid lizard *Varanus gouldii* and the elapid snakes *Suta suta* and *Pseudechis australis*), previously recorded in moderate to high numbers, were encountered in significantly lower numbers post-fire.

An increase in post-fire encounter rate was recorded for 17 species of reptile, with significantly higher numbers for the gecko *Strophurus elderi* (64 vs 2), the pygopodid lizards *Delma butleri* (86 vs 3) and *Lialis burtonis* (142 vs 9), and the skinks *Ctenotus leonhardii* (203 vs 6), *Ctenotus pantherinus* (179 vs 11) and *Tiliqua multifasciata* (200 vs 6).

Four species not recorded before the fire were found in the post-fire period. The small dragon lizard *Tympanocryptis tetraporophora* and the small elapid snake *Brachyurophis fasciolatus* were recorded once, however 5 individuals of the elapid snake *Demansia psammophis cupriceps* and 10 individuals of the small dragon lizard *Ctenophorus isolepis* were recovered post-fire.

The increase in the number of amphibians post-fire is attributed to the rain that extinguished the fire as the majority were found immediately following this event.

Table 3 sets out the daily capture rates in the 7 days before and after the fire for the 8 species of animal that had the biggest variation in numbers over this period.

## Discussion

Among the animals we were removing from the trench after the fire, there were marked increases in the number encountered of species that live within the spinifex or grass clumps. For the reptiles this included *Strophurus elderi* (2 vs 64), *Delma butleri* (3 vs 86) and *Lialis burtonis* (9 vs 142), *Tiliqua multifasciata* (6 vs 200), and for mammals *Pseudomys desertor* (0 vs 356).

By contrast a number of species that shelter in burrows or cracks in the ground, or burrow in sand declined in encounter rate post-fire. The most marked example among the mammals was the dasyurid *Sminthopsis macroura* (7 vs 4). For reptiles significant declines were recorded for the large varanid *Varanus gouldii* (21 vs 6) which lives in burrows, the large elapid snake *Pseudechis australis* (20 vs 10) and the small elapid snake *Suta suta* (12 vs 1) both of which are likely to live in burrows or cracks in the ground, and for two skinks, *Ctenotus regius* (12 vs 4) which lives in burrows, and *Eremiascincus phantasmus* (14 vs 1) which burrows in loose sand.

Snakes had a different pattern with only 30 recorded post-fire as against 49 recorded pre fire. Twenty three of the 30 were recorded on the 5th, 6th & 7th days. Only 2 species, the Western Brown Snake *Pseudonaja mengdeni* and the Yellow-faced Whipsnake *Demansia psammophis cupriceps* had a significant increase in numbers, while the Mulga Snake *Pseudechis australis* and the Curl Snake *Suta suta* had significant decreases. The sub species of the Yellow-faced Whipsnake found represents the first Queensland records. Frog numbers increased post fire as a result of the rain that extinguished the fire.

The fauna normally expected to be found in the trench would be from the immediate vicinity. However, each day post-fire saw more animals to remove. For those mammal and reptile species that showed a significant increase in post-fire encounter rate the total number of animals collected in the first day represented less than 20% of the total post-fire encounters, and considerable numbers continued to fall in the trench even as its length decreased progressively over the 7 days after the fire (see Table 3).

We did not have any real opportunity to examine the adjoining burnt areas in detail, but several quick walks across 100m or so did reveal the burnt remains of a few small lizards (*Diplodactylus conspicillatus* and *Ctenotus* spp). Potential predators were numerous, including Little Crows *Corvus bennetti* and Black Kites *Milvus migrans* both of which were very active. Feral cats and dingos were also evident but only on the first day after the fire. Sand goannas *Varanus gouldii* were conspicuous after the fire, usually early morning when they were basking at their burrow entrances, with all vegetation gone.

Many of the *Ctenotus pantherinus* and *C. leonhardii* would climb up the vertical wall of the trench but stay at the edge when they got to the top rather than dispersing. If predatory birds dived too close they would jump back into the trench. It seemed the animals almost sought the protection of the 1.5m deep trench possibly because the birds could not safely get into it. Despite there being earth ramps at about 500m intervals we saw no evidence that animals were using these to escape, although we saw several sand goannas entering the trench via these ramps.

Among the animals we were removing from the trench after the fire, there was a strong bias in favour of species that live within the spinifex or grass clumps rather than in burrows or cracks in the ground. This included *Strophurus elderi*, *Delma butleri*, *Lialis burtonis*

**Table 3.** For 8 species with the greatest increases, the numbers caught on a daily basis in the 7 days before and the 7 days after the fire.

| Species | 1/11 | 2/11 | 3/11 | 4/11 | 5/11 | 6/11 | 7/11 | Total |
|---|---|---|---|---|---|---|---|---|
| *P. desertor* | - | - | - | - | - | - | - | **0** |
| *P. tenuirostris* | - | - | - | - | - | - | - | **0** |
| *S. elderi* | 1 | - | 1 | - | - | - | - | **2** |
| *D. butleri* | 1 | 1 | - | 1 | - | - | - | **3** |
| *L. burtonis* | 3 | 5 | - | - | 1 | - | - | **9** |
| *C. leonhardii* | - | - | - | 2 | - | 2 | 2 | **6** |
| *C. pantherinus* | - | 1 | 3 | 2 | 1 | - | 4 | **11** |
| *T. multifasciata* | - | - | 3 | - | - | - | 3 | **6** |
| Total | 5 | 7 | 7 | 5 | 2 | 2 | 9 | 37 |

| Species | 8/11 | 9/11 | 10/11 | 11/11 | 12/11 | 13/11 | 14/11 | Total |
|---|---|---|---|---|---|---|---|---|
| *P. desertor* | 113 | 140 | 46 | 32 | 4 | 1 | 20 | **356** |
| *P. tenuirostris* | 1 | 4 | 15 | 6 | 4 | 5 | 6 | **41** |
| *S. elderi* | 1 | 22 | 18 | 10 | 3 | 10 | - | **64** |
| *D. butleri* | 19 | 5 | 5 | 5 | 14 | 28 | 10 | **86** |
| *L. burtonis* | 16 | 15 | 12 | 19 | 16 | 52 | 12 | **142** |
| *C. leonhardii* | 65 | 39 | 32 | 19 | 33 | 15 | - | **203** |
| *C. pantherinus* | 8 | 16 | 42 | 30 | 41 | 33 | 9 | **179** |
| *T. multifasciata* | - | 12 | 26 | 48 | 43 | 55 | 16 | **200** |
| Total | 223 | 253 | 196 | 169 | 158 | 199 | 73 | **1271** |

and *Tiliqua multifasciata.* It was also noteworthy, given the large number of *Lialis burtonis* recorded (142), that there was no significant variation in colouration. The species typically exhibits marked polychromatism within populations, yet every individual relocated was patterned with simple longitudinal stripes.

There was a huge volume removed from the trench but from what area had they been driven? The fauna normally found in the trench would be from the immediate vicinity but presumably the post fire multitudes had come from greater distances. On day 1 after the fire there were big numbers of displaced animals, but on days 2 and 3 there were just as many. Where did they come from? They had no place to hide in the trench other than the sacks we provided, but each day saw more to remove. We never saw any animals moving across the fire burnt landscape during the day or sheltering under equipment on the ROW. There was very little in the way of shelter sites adjacent to the ROW as logs were almost non-existent and obvious burrows, cracks or crevices were also very few. But many animals had survived up to 7 days in a completely burnt habitat before falling into the trench. They may have burrowed into loose soil or sand during the day then continued moving around at night, early morning or in the evening to try and find unburnt habitat. What would have happened if the trench was not there is not clear, but it appears to have functioned, in part, as a refuge. Injuries or burns were not evident and all animals seemed to be in very good condition.

There are many papers detailing changes to reptile and mammal diversity and composition following grass fires ( Reid *et al* 1993; Letnic 2003; Letnic *et al* 2004) but nothing describing what they do during and in the immediate aftermath of a fire apart from Giffiths 1995 study on the behaviour of Frillnecked lizards *Chlamydosaurus kingii* during and after fires in tropical northern Australia. It has been proposed that there is little mortality from the actual fire (Longmore and Lee 1981; Reid *et al* 1996; Pianka and Goodyear 2012) and it has been surmised that many would subsequently die from predation or starvation (Newsome *et al* 1975; Pianka and Goodyear 2012). This event certainly supports the view that many animals survive the flames, but also indicates that some of the survivors are able to avoid predation and starvation for extended periods of time and might well reach patches of unburnt ground cover.

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## References

**Griffiths, T. 1995.** We like our lizards frilled not grilled! The short-term effects of fire on frillneck lizards in the Top End. Pp. 87-90 In *Country in Flames*, edited by D.B. Rose. Biodiversity Unit of Department of Environment, Sport and Territories and Northern Australia Research Unit. Australian National University, Canberra and Darwin.

**Letnic, M. 2003.** The effects of experimental patch burning and rainfall on small mammals in the Simpson Desert, Qld. *Australian Wildlife Research* **30**: 547-563. http://dx.doi.org/10.1071/WR02093

**Letnic, M., C.R. Dickman, M.K. Tischler, B. Tamayo and C-L Beh 2004.** *The responses of small mammals and lizards to post-fire succession and rainfall in arid Australia.* Journal of Arid Environments **59**: 85-114. http://dx.doi.org/10.1016/j.jaridenv.2004.01.014

**Longmore, R. and Lee, P. 1981.** Some Observations on Techniques for Assessing the Effects of Fire on Reptile Populations in Sturt National Park. *Australian Journal of Herpetology* **1**: 17-22.

**Mecke, S., Doughty, P. and Donnellan, S.C. 2013.** Redescription of *Eremiascincus fasciolatus* (Gunther, 1867) (Reptilia: Squamata: Scincidae) with clarification of its synonyms and the description of a new species. *Zootaxa* **3701(5)**: 473-517. http://dx.doi.org/10.11646/zootaxa.3701.5.1

**Menkhorst, P. and Knight, F. 2011.** *A Field Guide to the Mammals of Australia.* Third edition. Oxford University Press, Melbourne, Australia.

**Newsome, A.E., McIlroy, J. and Catling, P. 1975.** The effects of an extensive wildfire on populations of twenty ground vertebrates in south-east Australia. *Proceedings of the Ecological Society of Australia* **9**:107-23.

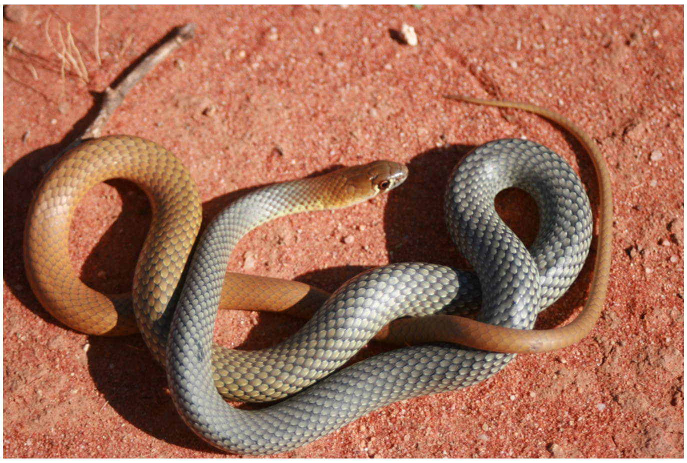
**Pianka, E.R. and Goodyear, S.E. 2012.** Lizard responses to wild fire in arid interior Australia: Long-term experimental data and commonalities with other studies. Australian. Ecology. 37:1-11. http://dx.doi.org/10.111/j.1442-9993.2010.02234.x

**Reid, J.W., J.A. Kerle and S.R. Morten 1993**. Uluru fauna. The distribution and abundance of vertebrate fauna of Uluru (Ayers Rock-Mount Olga) National Park NT. *Kowari* **4** ANPWS, Canberra.

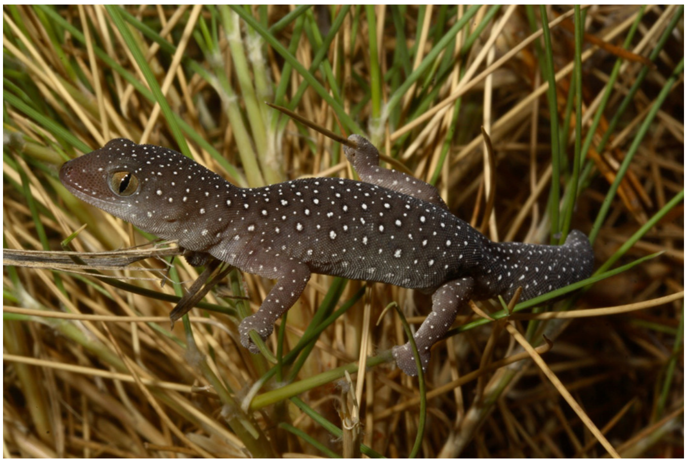
**Wilson, S. and G. Swan 2014.** *A Complete Guide to Reptiles of Australia.* New Holland Publishers, Chatswood, Australia.

## APPENDIX I

Dingos were commonly seen along the Right of Way.

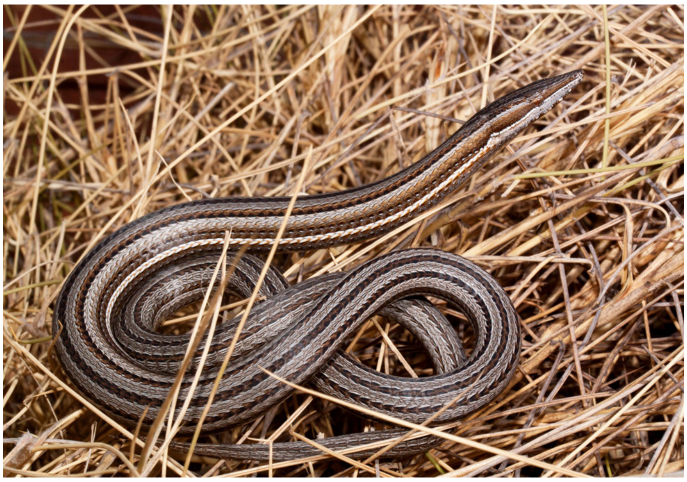


*Demansia psammophis cupriceps* a sub species of the Yellow-faced Whipsnake.



The Jewelled Gecko *Strophurus elderi* a species confined to spinifex clumps.

Centralian Bluetongue *Tiliqua multifasciata.* The hummock grasslands appear to support large numbers of this lizard.



All *Lialis burtonis* recorded were the one colour pattern.